NATIONAL LUBRICATING GREASE INSTITUTE

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*Breaking in a New Engine**

THE PRECAUTIONS NECESSARY AND THE REASONS FOR THEM

By Frederic R. Speed

Automotive Engineer, Pennsylvania Grade Crude Oil Association

Each year many thousands of motor vehicle engines are severely harmed during the first few miles of use by owners who do not realize the importance of properly breaking them in. Fleet operators long ago learned how costly careless or unintelligent break-in can be and most of them have developed procedures to assure the rapid and thorough conditioning of the engine before it is placed in regular service.

Proper break-in will assure maximum engine life, and the development of the highest performance and economy from the engine. To accomplish satisfactory break-in, adequate lubrication and a proper procedure during the critical period when the bearing surfaces of the engine are wearing in is essential. Passenger car manufacturers place instructions in their cars advising owners how to operate the engine when it is new. In particular they warn against high speeds and of the necessity for careful operation until the bearing surfaces are smoothed down. To be read, these instructions must be brief and they cannot explain the reasons for the procedure suggested.

Engines are designed to operate with certain fixed clearances between their moving parts. When, for any reason, these clearances become excessive the efficiency of the engine will be seriously impaired and replacement or repair of the affected parts becomes necessary before the engine will again deliver its normal power and economy. Wear will occur even with adequate lubrication and intelligent care but when the engine is properly broken in it may be operated for forty or sixty thousand miles or more before sufficient wear occurs to necessitate the replacement of engine parts.

The rate of wear in an engine will depend upon the smoothness of the new bearing surfaces of its moving parts, upon the break-in procedure, upon the care exercised in keeping it properly lubricated and protected against harmful materials, and finally upon the type of service in which it is used.

The relative smoothness of the bearing surfaces depends upon the kind of finishing operation used in their manufacture. This may range from ordinary machining, in which the surface irregularities are easily visible to the naked eye, to lapping and polishing which produce mirror-like surfaces with microscopically small irregularities. Of course, the surface which is finished to the greatest smoothness will wear in most quickly and with least danger of injury if adequately lubricated. Less heat will be generated because the irregularities are less and a smaller amount of material must be worn off.

Whatever the type of finish, the new surfaces will begin to wear in when the engine is run. This wearing in consists of shearing off the high points of the metal as the surfaces move against one another. Very high temperature is produced at each point where this shearing occurs and enough heat may be generated to cause welding of small sheared off particles to the opposite surface even with a copious supply of good lubricant. It is obvious that if the engine is run fast or under heavy load for an appreciable time, during this break-in period enough heat will be generated to cause such welding and produce rough bearing surfaces. Such surfaces are difficult to lubricate and deteriorate rapidly, thus shortening the bearing life.

While other bearing surfaces in the engine are given fine finishes, the piston rings, after accurate grinding, are treated to give the surface which bears against the cylinder wall a very thin rough coating. This permits rapid seating of the surfaces and after they are properly worn in provides a long wearing surface on both the piston ring and the cylinder wall.

During the break-in period the quality of the lubricant is especially important because the conditions which may exist locally in the engine can be severe enough to permanently harm or even destroy some of its parts.

Since the clearances in a new engine are quite small, a light bodied oil of about SAE 10W viscosity should be used during the break-in period so that it may penetrate these small clearances promptly and cover all of the surface with lubricant. Preferably, this oil should be highly resistant to deterioration so that it will not oxidize readily and form undesirable or harmful materials in the engine, and it should have a viscosity index such that it will not thin out to a dangerous degree nor vaporize at the temperatures encountered and thus fail to protect the bearing surfaces with an adequate film.

Several methods for breaking in the engine are successfully practiced. One, which is very usual among private owners, is to drive the car for the first several hundred miles at a speed around twenty-five miles per hour and to gradually increase the driving speed until at around five hundred miles it is in the neighborhood of 40 mph.

At proving grounds, where cars which are to be run on various tests must be thoroughly and rapidly conditioned, several varia-

tions of quick break-in are successfully used. A composite of the best of these methods which is widely and successfully used is offered. It is simple, safe, produces good results and can be carried out by any car owner.

When the new car is delivered to the owner, the engine has been run but a few miles and quite probably has never attained normal operating temperature. In any case, no matter how carefully the engine is cleaned before installing it in the car some dirt, iron particles and similar material will remain in it. It is therefore, a wise precaution to idle the engine until it is warm and then drain out the original oil and replace it with a high quality oil of 10W viscosity as recommended by the manufacturer.

With a charge of fresh clean oil in the crankcase the engine should be thoroughly warmed up by idling and then driving for a half hour or so at around 20 mph. in high gear. Then accelerate rather quickly from 20 to 30 mph. and immediately let the speed fall back to 20 mph. without touching the clutch or brake. This should be repeated for about a half hour with intervals of steady driving at about 25 mph. Special attention should be paid to the "feel" of the engine. If it feels stiff or tight continue the preceding accelerating and driving runs until it feels free and active.

Now the speed may be stepped up and accelerating runs made from 25 to 35 mph. with intervals of steady driving at 30 mph. After about a half hour of this procedure, if the engine feels free step up the runs five more miles per hour and continue until a top speed of 50 mph. is reached. If these runs are not made consecutively the engine should be carefully warmed up each time as directed at the beginning of the procedure. It is suggested that until 200 or 250 miles have been run the car speed be kept at or below 50 mph.

Oil Change at 200 or 250 Miles Advisable

At about 200 to 250 miles a change of crankcase oil is advisable for two reasons. First, particles of metal have been worn off of the bearing surfaces due to wearing-in. Some of this material is abrasive and none of it is good for the engine. Second, the new surfaces and the fine material worn off of them tend to make the oil oxidize to form sludge, varnish, acids and other harmful material much more rapidly than would normally occur in an engine which has been broken in. Even with a filter on the engine the oil should be drained frequently, especially in a new engine, to remove these materials and thus insure against excessive wear, corrosion and harmful deposits of varnish and sludge.

After the oil change the acceleration procedure may be continued to higher speeds, with intervals of steady driving at around 40 mph. As the engine frees up more and more the speeds may be gradually increased but care should be exercised at all times against a tendency for the engine to tighten up and it should not be worked too hard.

At 500 miles the oil should be changed again for the same reasons as previously given, and again at 1000 miles. These may seem to be frequent changes but will add many miles of life and much satisfaction to the ownership of the car.

The foregoing procedure, intelligently followed will condition your engine for normal driving in 1000 miles or less. However, extremely hard service should be avoided, if possible, before the 2000 mile mark is reached.

The wisdom of using a high quality lubricant of suitable grade and changing it very frequently during the break-in period cannot be overemphasized. Any oil will deteriorate very much more rapidly in a new engine than in one which has been well broken-in. A high quality oil, with great resistance to oxidation and satisfactory viscosity index, will provide the greatest protection to a new engine as well as one which has been broken-in.

Oil filters are always helpful but during the break-in period they should not be counted on too much. Abrasive materials accumulate and should be promptly removed while sludge, varnish, acids and similar materials formed by the oxidation of the oil

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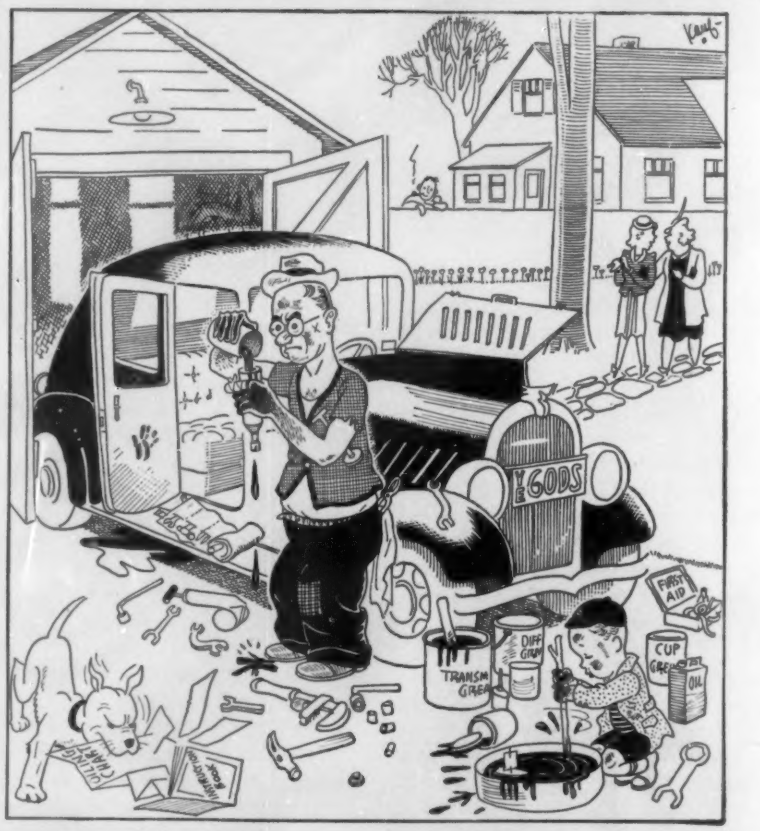
HOW TO GREASE YOUR OWN CAR



First, put on your dirtiest clothes so you can crawl under the car.

Second, buy a supply of transmission, differential, universal joint, water pump, and pressure gun greases, a grease gun, and a spray gun. Also some penetrating oil.

Third, equip yourself with lots of strong words like "Darn" and "Oh Hang" to use on the joints where the grease doesn't want to come through. Use the words until it comes out the other side.

Fourth, buy yourself a complete set of wrenches to use on the containers that must be opened to inspect the lubricating supply inside. Also some new skin to graft on your knuckles after a wrench slips.

Fifth, fill your spray gun with penetrating oil to spray on the springs. Be sure not to breathe while spraying the springs or you may oil-plate the inside of your lungs, which is bad.

Sixth, be sure not to miss any place that should be lubricated as it may cost you the price of 20 grease jobs for repairs.

Or, if this seems like too much trouble call your nearest service station today. They call and deliver, and can assure you of Verified Lubrication.

*Rationalizing Lubricating Grease**

By Martin B. Chittick, The Pure Oil Company

(Continued from previous issue)

Ahlberg (11) and Gillett (12) on their investigation of grease in the Bearing Engineers Committee and employing the Bearing Engineers Committee machine and procedure tests, have made a substantial contribution from the consumer interests to the producer interests on the quality of stability. This contribution not only covers the stability as to soap and oil separation but further change in structure and texture, change in consistency, channeling, and increases in volume in service.

Kaufman (13) has contributed a mechanical means of evaluating ball and roller bearing greases and a procedure of test supported by considerable data, which indicates the trend in evaluation of greases in terms of performance. This investigation has been predicated by the following important criteria:

1. Ease of application.
2. Stability in storage (where bearings are packed in grease).
3. Torque characteristics (running and starting torques at high and low temperatures).
4. Leakage.
5. Adherence of grease to the bearing.
6. Temperature of operation.

Kaufman's work, besides giving a measure of these important characteristics, also gives reproducible results. The data indicate that the tendency of a grease to become softer on working down bears no relationship to leakage tendency. The assumption that milling a grease imparts to it the final worked consistency to be expected after use in antifriction bearings and thereby giving superior performance in relation to an unmilled grease is not confirmed.

Early work by Buckley and Bitner (14) on the breakdown in grease structure, due to working, was studied by the means of the Bitner Grease Consistometer. An excellent contribution has been made by Farmington and Humphries (15) on the effect of pressure on lubricating greases utilizing the press designed by Herschel in 1933. In this procedure the grease in confined and subjected to pressure, and the oil, squeezed out thru filter paper, is immediately absorbed. From their data, they have arrived at an emperical formula for loss. It is significant that all samples on which their work was carried out, were worked in an A.S.T.M. worker, but it should be noted that this pre-working made a difference of only approximately 2% in the oil loss, indicating that no fundamental change occurred due to working. It is also of further interest to learn that from two greases made with oils of wide difference in viscosity, the initial loss of oil was much more rapid in the low viscosity oil but that the ultimate loss of oil for both greases was essentially the same. The initial and ultimate loss of oil was increased by pressure. Further, the oil loss of sodium soap greases was higher than that of calcium soap and aluminum soap greases. The "bleeding" of oil from grease is increased by increasing the mineral oil content and decreasing the viscosity of the oil, increasing the coarseness of soap fibers, and increasing pressure and temperature.

Eight—National Lubricating Institute

Gruse (10) and his associates have stated that chemical stability of grease may be influenced by (a) the environment of a grease, including both the conditions and the substances with which it comes in contact, and (b) the deleterious constituents in the grease itself. They have offered a theory of chemical deterioration due to oxidation, hydrolysis, bleeding, and the influence of water and metals.

It has been generally recognized that a standard test for stability would be highly desirable and since the above work definitely indicates that such a test is feasible, further research work should result in developing such a test.

It is not possible within the scope of this paper to discuss all of the work that has been carried out by various technologists under the subject of stability, but only sufficient material has been offered to indicate the trend and that trend has been largely influenced by service demand.

As conceived in this paper the rationalization of lubricating greases is an attempt to push aside some of the mystery that has always surrounded this class of lubricants and to present some of the problems involved to the end that, in part at least, some of the misunderstandings may be removed and that the problems may be attacked in a logical manner and that better lubrication from lubricating greases may be secured. While the problems, so far as research and development are concerned, are fundamentally the responsibility of the grease manufacturer, nevertheless, a happy conclusion cannot be reached without the cooperation of the manufacturers of mechanical equipment as well as the consumers. By open admission of the shortcoming in our lubricating greases and the factors involved the groundwork for progress is laid and successful culmination will work to mutual advantage and the modest effort of this author will have attained the rational objective.

As before mentioned, the scope of this paper is inadequate to completely discuss the entire subject. There is, therefore, appended a complete bibliography on this subject of lubricating greases. A review of the literature always being the first and logical step in the technical approach to any problem.

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GEORGE W. MILLER .... *Editor*

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Associate Editors

J. R. Battenfeld W. H. Oldacre
M. B. Chittick W. H. Saunders
E. V. Moncrieff H. C. Vesper

BREAKING IN A NEW ENGINE

(Continued from page 2)

are produced more rapidly and in larger quantity than after the engine is broken-in. A filter can clean only a portion of the oil at one time and it cannot remove all of the products of oil decomposition. Filters should be examined when the oil is changed and replaced if necessary.

Of course the engine will not fall to pieces if you break it in carelessly, although there are plenty of authentic cases where bearings and other parts have failed from this cause. It is much more likely that the harm which is done in this critical period will not show up, for ten thousand miles or more, but that then a number of things may begin to occur which will cause dissatisfaction with the performance of the engine and which may be costly to correct. A careful break-in by any intelligent procedure, with frequent oil changes, will put dollars in the owner's pocket and regular frequent oil changes using high quality oxidation resistant oil will add to them.

*Car Manufacturers' Recommendations**

REVISED LUBRICATION SPECIFICATIONS 1941 STUDEBAKER—ALL MODELS

Studebaker has issued revised engine oil recommendations, which are as follows:

"The engine oil specifications give general coverage for all operating and climatic conditions. For cars equipped with the overdrive transmission, the next lighter oils can be used (except in the case of SAE 10). For example, SAE 20 can be used in place of SAE 30, and SAE 10 in place of SAE 20. These lighter engine oils can also be used in conventional transmission equipped cars operating at speeds below 60 mph."

Lubricant specifications for transmissions with overdrive also have been revised. The new specifications are:

"Use SAE 40 engine oil or a high grade mineral oil gear lubricant of SAE 90 viscosity for both summer and winter. Gear lubricants containing any extreme pressure ingredients, such as lead, sulphur, or chlorine compounds must not be used."

WILLYS "PLAINSMAN" MODEL

At the time we announced the new Willys model with transmission overdrive, known as the "Plainsman", we stated that a chrome plate with the name "Willys Plainsman" appears on the side of the hood on cars equipped with overdrive.

We have since been advised that such a plate was placed on the pilot models only and not carried through on production, and that the only way they can be distinguished from cars without overdrive is by the knob on the instrument panel, for the cutting in and out of the overdrive.

CLEANING THE CONVERTIBLE COUPE TOP

Convertible Coupe fabric top material is composed of two liners of fabric (an inner and outer cover) cemented together with a layer of rubber. This inner layer of rubber gives the top its waterproof qualities. When the top is stretched, as in the raised position, saturation of the outer cover with a volatile cleaner, such as naphtha, gasoline, etc., will reach the inner rubber layer and impair the waterproof qualities of the top. Avoid the use of a volatile cleaner; but if it is used at all for removing grease spots, it should be used very sparingly. The best way to clean a convertible coupe top is to use a brush or whisk broom and then wash the top material with a mild soap and tepid water.

—*Pontiac Service News.*

FORD STARTS DELIVERY ON NEW 6

Development work has been under way for many months on a Ford Six. A number of these have been in active service for some weeks by leading Ford dealers and distributors and in the hands of a few fleet owners.

On May 20, Ford released information to the press that while the Six was originally intended to be brought out early this year, yet because of priorities given to arms work, however, normal production of the new model will not be in full swing until early Fall.

The new car is said to be the same in all respects as the present V-8 except for the engine, which is interchangeable with the V-8.

Preliminary and unconfirmed capacities are: Crankcase 5 qt., Cooling System 22 qt. Others same as V-8. Motor oil recommendations are the same as for the V-8. Water pump, distributor and generator require lubrication with motor oil.

1940 PONTIAC VENTILATOR OUTLET

On 1940 Pontiac models, a small filter element was used in the lower end of the ventilator outlet pipe to prevent the intake of dust laden air when the engine was stopped. Since cleaning of these filter elements is invariably neglected, it is recommended that they be removed from all 1940 cars and discarded.

If a 1940 car is driven in an extremely dusty area where a filter in the ventilator outlet pipe is required, it is recommended that the 1941 Heavy Duty Ventilator Outlet Pipe and Filter should be installed.

—*Pontiac Service News*

PACKARD CLIPPER HAS VENTALARM

The gas tank of the new Packard Clipper is equipped with the new Ventalarm whistle. This permits rapid full force filling of the gas tank, as the whistle continues to sound until the tank is within 1 gal. of being full (provided car is on level ground), at which time the whistle stops. To prevent overflowing, the attendant should fill with gas only while the whistle sounds.

NOW THEY USE MORE CURRENT

Pontiac engineers, in pointing out the necessity for an exceptionally high out-put generator on the modern car, show the following sources of electrical consumption; lights and ignition, 12.5 amperes; car heater, 5.0 amps.; radio, 7.5 amps.; defrosters, 3.5 amps. These are the major sources of electrical consumption. To them must be added the drain of extra horns, stop lights, direction indicators, spotlights, fog lamps, etc.

FORD 6 HAS NEW FEATURES

The new Ford 6 started a limited production in May for general distribution to the public. Previous to that time a limited number of models had been placed in the hands of Ford Dealers and with some fleet accounts for a thorough test and service reports. Production limited by priorities orders will be carried on at least through October and just how many can be built will depend, to a great extent, on the availability of materials.

The new Ford 6 engine is of entirely new design, containing many new engineering features.

So far as lubrication service is concerned, the following differences will be found between the new 6 and the V-8.

The battery on the 6 is on the left side, whereas on the V-8 it is on the right side.

The single water pump on the 6 requires lubrication with motor oil every 1,000 miles. An oil reservoir surrounds a porous bushing. The water pumps on the V-8 require no manual lubrication and are not shown as lubrication points on the chart.

The generator on the 6 is on the left side of the cylinder block at the forward end, whereas on the V-8 it is between the cylinder blocks at the top forward center.

The crankcase filler on the 6 is at the left side, and on the V-8 it is at the rear center of the engine.

Capacities and recommendations of crankcase, transmission and differential for the 6 are the same as for the V-8, but the cooling system of the 6 has a 17½ qt. capacity.

There is one more point to lubricate on the 6 than on the V-8.

Aside from the power plant, all other lubrication points on the 6 and the V-8 are the same because the chassis of the two cars are identical and the power plant is interchangeable.

On the Ford 6 the new oil pump assembly is driven direct from a gear at the front end of the crank shaft. Removal of the oil pan drain plug also removes the oil intake screen which is an integral part of the plug. This permits thorough cleaning of the screen with each oil change.

There is a new type of high pressure, balanced, 6 bladed water pump that is self sealing and requires no further adjustment during the life of the pump.

There is a twin belt drive to the generator and water pump. Each belt can be individually adjusted.

Who Am I?

I am more powerful than the combined armies of the world.

I have destroyed more men than all the wars of the nations.

I am more deadly than bullets, and I have wrecked more homes than the mightiest of siege guns.

I spare no one, and I find my victims among the rich and poor alike, the young and old, the strong and the weak.

Widows and orphans know me.

I massacre thousands of wage-earners in a year.

I lurk in unseen places, and do most of my work silently.

You are warned against me, but you heed not.

I am relentless.

I am everywhere — in the home, on the streets, in the factory, at railroad crossings and on the sea.

I destroy, crush, or maim; I give nothing, but take all.

I am your worst enemy.

I am CARELESSNESS.

Invisible Mileage — Motor Miles

In its 1941 Lubrication Program, the American Petroleum Institute Lubrication Committee brings out some startling facts on automobile accidents and automobile repairs as they may result from lack of proper lubrication — facts that will help service station salesmen to talk convincingly on 1,000 mile lubrication and oil-change.

For instance, there's the story of "Motor Miles."

Many motorists fail to realize that the motor travels many more miles than the speedometer indicates. The idling time spent waiting for traffic lights, warming up before starting, stopping to make a left turn, or parking with the motor running, keeps the motor turning over even though the car is not moving. This idling time can be measured by an instrument called a "Motor Mile Tachometer," and translated by the number of revolutions into actual miles, called "motor miles."

Tests made by the Tachometer show that, while a car has traveled 1,000 miles along the road (road miles), the miles traveled by the motor (motor miles) may be more than 1,500 miles under certain driving conditions.

This fact is important in relation to

crankcase oil-change, for oil-change is measured on road miles, as indicated by the speedometer, and not on motor miles, as indicated by the revolutions of the motor. The motorist who drives beyond the 1,000 mile oil-change recommended by his service station may be using oil that has been exposed to the heat, acid and dirt within his motor for many more miles than his speedometer shows.

These invisible miles — the miles the motor travels, that don't show on the speedometer — are the miles that give friction time to do its dirty work in the engine, unseen and unsuspected.

Tell your customers and prospects about these invisible miles . . . Remind them that a car is only as good as the care it is given . . . Tell them to LUBRICATE FOR SAFETY EVERY 1,000 MILES!

(Continued from page 4)

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